

REMARKS

Claims 1, 4, 5, 7, and 8 are pending in the present application.

Claims 2, 3, and 6 have been cancelled without prejudice or disclaimer to the subject matter contained therein.

I. ARGUMENTS

A. Rejection of Claims 1, 2, and 4 - 8 under 35 U.S.C. §112, First Paragraph

Claims 1, 2, and 4-8 have been rejected under 35 U.S.C. §112, first paragraph, for failing to provide a written description of the claimed invention. This rejection, in view of the above amendments, is moot.

In formulating the rejection under 35 U.S.C. §112, first paragraph, the Examiner alleges that the originally filed specification fails to provide a written description of a nozzle submerged in liquid gallium.

Figure 2 is a cross-sectional illustration of the neutron generating portion of the accelerator based neutron source 12 of Figure 1 and associated cooling system. The portion of the accelerator based neutron source 12, as set forth in the originally filed specification (at page 6, lines 1-3), includes a stainless steel housing 31 within which is a beryllium target 32. This target is bombarded with either protons or deuterons on a surface 33 of the beryllium target 32. As a result of proton or deuteron interactions in the beryllium target 32, a neutron flux is generated, as set forth in the originally filed specification (at page 6, lines 3-4). The neutron flux passes through the gallium-filled reservoir and stainless steel housing and is emitted from the accelerator based neutron source 12. Since the heat flux in the beryllium is extremely high, the present invention utilizes liquid gallium to cool the beryllium target 32, as set forth in the originally filed specification (at page 6, line 4).

The accelerator based neutron source 12, as illustrated in original Figure 2 and as set forth in the originally filed specification (at page 6, lines 5-6), includes a stainless steel nozzle 34 that receives the liquid gallium and injects a concentrated jet of liquid gallium 37 onto the back surface 39 of the beryllium target 32. Since the outlet 30, as illustrated in original Figure 2, from

the stainless steel housing 31 is located above the top surface of the beryllium target 32, the reservoir 40 will fill with liquid gallium. More specifically, the originally filed specification, at page 6, lines 7-8, explicitly states that liquid gallium fills the chamber 40 and exits therefrom.

Thus, the originally filed specification teaches that the jet of liquid gallium 37 is submerged in the reservoir 40 because the reservoir 40 is filled with liquid gallium.

The liquid gallium will exit out of the housing through the outlet 30 where it will be piped to the heat exchanger 24 to remove the latent heat.

In addressing the Applicant's arguments, the Examiner alleges that Figure 2 fails to illustrate that nozzle 34 is even in chamber 40. This assertion by the Examiner is unsupportable in view of the original specification. The original specification (at page 5, line 6) indicates, "Figure 2 is a cross-sectional illustration of the neutron generating portion of the accelerator based neutron source." [Emphasis added.]

Thus, Figure 2 illustrates all objects with respect to a certain plane. Since nozzle 34 is illustrated with chamber 40 and the illustration is a cross-sectional view, nozzle 34 must be in chamber 40, otherwise the view cannot be a cross-sectional view.

The Examiner further counters that even if the nozzle 34 is in chamber 40, the original specification fails to teach that the chamber 40 is filled enough to submerge the nozzle 34. The original specification explicitly states that the liquid gallium **fills** the chamber 40. The original specification does **NOT** teach a partial fill. Thus, the ordinary meaning of the original specification clearly teaches the skilled artisan that the chamber 40 is filled enough to submerge the nozzle 34.

As noted previously, the original specification indicates that the testing of the invention with a water coolant produced a submerged jet impingement. Thus, the same configuration using liquid gallium would produce a submerged jet impingement. As taught by Pais et al. (on page 182, first sentence of the third paragraph), the various submerged jet impingement configurations were realized by utilizing a submerged nozzle.

However, the Examiner argues that Pais et al. teaches the existence of a submerged jet without realizing a submerged nozzle. This position is contrary to the explicit teachings of Pais et al. More specifically, Pais et al. teaches, at the end of the article, on page 182, first sentence of the third paragraph, that "in all of the above cases the surface [target] and nozzle were fully

submerged.” The submerged nozzle, as taught by Pais et al., created a submerged jet. Thereafter, Pais et al. teaches a free jet impingement configuration wherein the nozzle is not submerged.

Therefore, contrary to the Examiner’s contentions, Pais et al. only teaches the existence of a submerged jet impingement when utilizing a submerged nozzle. Pais et al. fails to teach or even suggest the existence of a submerged jet impingement without utilizing a submerged nozzle.

The Examiner contends that since pages 7 and 8 of the original specification does not mention a submerged jet or submerged nozzle when describing a liquid gallium test, the specification clearly fails to a submerged nozzle. It is noted that pages 7 and 8 also do not mention the chamber, the heat exchanger, etc. In view of this omission, it appears that the Examiner would contend that the original specification also does not support any elements of the claims because the description of the liquid gallium test fails to mention each of these claimed elements.

Lastly, the Examiner contends that the disclosure is silent with respect to the outlet being located at the top surface of the target. Notwithstanding, the Examiner asserts that the nozzle 34 of Figure 2 of the above-identified application need not be submerged when producing a submerged jet.

Since the Examiner has recognized that the originally filed specification teaches a submerged jet, the Applicant respectfully requests that the Examiner clearly demonstrate, using Figure 2 as a basis, how the liquid gallium travels from the nozzle, produces a submerged jet which impinges upon the target, and exits out the outlet without submerging the nozzle. If the Examiner cannot demonstrate how the liquid gallium travels from the nozzle, produces a submerged jet which impinges upon the target, and exits out the outlet without submerging the nozzle, Figure 2 must necessarily illustrate the submersion of the nozzle to produce a submerged jet which impinges upon the target.

To demonstrate the Applicant’s position and to demonstrate that the Examiner cannot establish a configuration wherein the liquid gallium travels from the nozzle, produces a submerged jet which impinges upon the target, and exits out the outlet without submerging the

nozzle, Figure 2 has been annotated to show the necessary liquid gallium level to facilitate both exiting from the outlet and creating a submerged jet.

In the first annotation of Figure 2, the neutron generating portion of the accelerator based neutron source is orientated such that the outlet is above the nozzle. In this annotation, it is very clear that the level A of the liquid gallium would be such to submerge the nozzle in order to both exit the outlet and create a submerged jet

37.

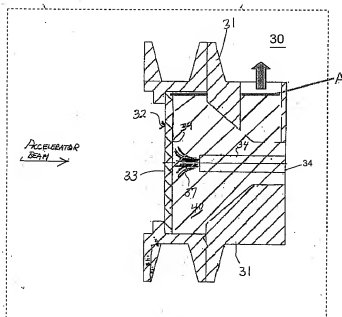


FIG. 2

In the second annotation of Figure 2, the neutron generating portion of the accelerator based neutron source is orientated such that the outlet is below the nozzle. In this annotation, it is very clear that the level A of the liquid gallium would be such to submerge the nozzle in order to both exit the outlet and create a submerged jet 37.

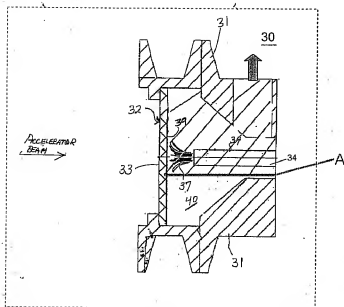


FIG. 2

Accordingly, in view of the remarks set forth above, the Examiner is respectfully requested to reconsider and withdraw this rejection.

B. Rejection of Claims 1 and 5 under 35 U.S.C. §103

Claims 1, 4, 5, and 7 have been rejected under 35 U.S.C. §103 as being unpatentable over Eggers (US Patent 5,392,319) in view of Lidsky et al. (US Patent 5,784,423), Pias et al. (IEEE Article), and Alger et al. (US Patent 4,141,224). This rejection is respectfully traversed.

Independent Claim 1

As submitted above, independent claim 1 sets forth a method of cooling a low Z target material of a neutron source assembly by providing, by using a nozzle submerged in liquid gallium, a submerged jet of concentrated liquid gallium in a direction normal to a non-bombarded surface of the low Z target material within the neutron source assembly to cool the low Z target material; providing a reservoir of liquid gallium; and pumping the liquid gallium, serially, from the reservoir, through the nozzle, such that the liquid gallium impinges upon the low Z target material in the neutron source assembly and cools the target material, from the neutron source assembly directly to a heat exchanger to remove heat from the liquid gallium, and from the heat exchanger to the reservoir.

Initially, as recognized by the Examiner, Eggers fails to disclose cooling a low Z target material of a neutron source assembly with liquid gallium. To meet this deficiency in Eggers, the Examiner asserts that Eggers can be modified by the teachings of Lidsky et al. because the Examiner alleges that the teaching of Lidsky et al. with respect to cooling a low Z target material of a neutron source assembly with liquid gallium is an acceptable equivalent to cooling with water as taught by Eggers. The Examiner's motivation is incorrect.

More specifically, the liquid gallium of Lidsky et al. is incompatible with the system of Eggers because Eggers discloses a neutron source assembly constructed of aluminum. Liquid gallium dissolves aluminum or copper in a matter of minutes or a few hours depending on temperature. Thus, one of ordinary skill in the art would not combine the teachings of Eggers with the teaching of Lidsky et al. to realize a system to cool a low Z target material of a neutron source assembly with liquid gallium because the liquid gallium would dissolve the aluminum neutron source assembly of Eggers.

Since Lidsky et al. discloses a coolant, liquid gallium, which would dissolve the aluminum neutron source assembly of Eggers, the proposed combination of Eggers, Lidsky et al., and Pais et al. fails because the teachings of Lidsky et al. are antithetical to the teachings Eggers in that the system of Eggers would be rendered inoperable if liquid gallium were utilized as a coolant.

Moreover, as recognized by the Examiner, Eggers, and Lidsky et al., singly or in combination, fail to disclose a nozzle submerged in liquid gallium. To meet this deficiency in Eggers, and Lidsky et al., the Examiner asserts that Eggers and Lidsky et al. can be modified by the teachings of Pais et al. because the Examiner alleges that the teaching of Pais et al. a nozzle submerged for cooling a low Z target material of a neutron source assembly. The Examiner's motivation is incorrect.

The liquid gallium of Lidsky et al. is incompatible with the system of Pais et al. because Pais et al. discloses passing the coolant over a block of copper. As noted above, liquid gallium dissolves copper in a matter of minutes or a few hours depending on temperature. Thus, one of ordinary skill in the art would not combine the teachings of Lidsky et al. with the teaching of Pais et al. to realize a nozzle submerged for cooling a low Z target material of a neutron source assembly because the liquid gallium would dissolve the copper block of Pais et al.

Since Lidsky et al. discloses a coolant, liquid gallium, which would dissolve the copper block of Pais et al., the proposed combination of Eggers, Lidsky et al., and Pais et al. fails because the teachings of Lidsky et al. are antithetical to the teachings Pais et al. in that the system of Pais et al. would be rendered inoperable if liquid gallium were utilized as a coolant.

Furthermore, as recognized by the Examiner, Eggers, Lidsky et al., and Pais et al., singly or in combination, fail to disclose pumping the liquid gallium, serially, from the reservoir, through the nozzle, such that the liquid gallium impinges upon the low Z target material in the neutron source assembly and cools the target material, from the neutron source assembly directly to a heat exchanger to remove heat from the liquid gallium, and from the heat exchanger to the reservoir, as set forth by independent claim 1.

To meet this deficiency in the combined teachings of Eggers, Lidsky et al., and Pais et al., the Examiner proposes to modify the teachings with the teachings of Alger et al. The Examiner contends that Alger et al. teaches pumping the liquid gallium, serially, from the reservoir, through the nozzle, such that the liquid gallium impinges upon the low Z target material in the neutron source assembly and cools the target material, from the neutron source assembly directly to a heat exchanger to remove heat from the liquid gallium, and from the heat exchanger to the reservoir.

Notwithstanding the Examiner's contentions, Alger et al. teaches pumping a liquid coolant, serially, from the reservoir (23), through the nozzle (29), such that the liquid coolant impinges upon a target material (11) in chamber (13) and cools the target material (11). Alger et al. further teaches that the liquid coolant exits the chamber (13) and flows directly back to the reservoir (23). Lastly, Alger et al. teaches that the liquid coolant in the reservoir (23) may be pumped serially, from the reservoir (23), back through the nozzle (29), or the liquid coolant in the reservoir (23) may travel through a heat exchanger (28). In other words, Alger et al. teaches that the liquid coolant leaving the chamber (13) is fed directly to the reservoir (23) and that the liquid coolant may pass through the heat exchanger (28).

Thus, Alger et al., unequivocally, fails to disclose or suggest pumping the liquid gallium, serially, from the reservoir, through the nozzle, such that the liquid gallium impinges upon the low Z target material in the neutron source assembly and cools the target material, from the neutron source assembly directly to a heat exchanger to remove heat from the liquid gallium, and from the heat exchanger to the reservoir, as set forth by independent claim 1.

Lastly, in addressing the Applicant's arguments, the Examiner dismisses the contention that the liquid gallium of Lidsky et al. is incompatible with the systems of Eggers and Pais et al. due to its corrosive nature and asserts that the Applicant has admitted that copper is a proper material for constructing a container for a liquid gallium coolant used in conjunction with a neutron source assembly.

Initially, the Examiner is respectfully requested to substantiate the validity of the Examiner's contention that the Applicant has admitted that copper is a proper material for constructing a container for a liquid gallium coolant used in conjunction with a neutron source assembly.

The original specification does discuss copper as being a material for constructing a container for a liquid gallium coolant used in conjunction with a neutron source assembly. Moreover, the Applicant has not expressly stated in any of the previous Response that copper is a proper material for constructing a container for a liquid gallium coolant used in conjunction with a neutron source assembly. Therefore, the Examiner is respectfully requested to withdraw the unverifiable statement regarding Applicant's admissions concerning copper and further to refrain from making such unverifiable statements in future Office Actions.

The Examiner also asserts that Morel et al. (US Patent 6,258,620) discusses a liquid gallium container made of copper. It is respectfully noted that the Examiner has failed to formally include Morel et al. as a reference upon which the rejection under 35 U.S.C. §103 is based.

Although Morel et al. discloses, at column 5, lines 15-27, a shallow container made of copper for providing a liquid gallium sputtering source, Morel et al. fails to disclose liquid gallium can be utilized with a copper or aluminum based neutron source assembly as disclosed by Eggers.

It is respectfully submitted that shallow container made of copper for providing a liquid gallium sputtering source, as taught by Morel et al., is not subjected to the temperatures experienced within a neutron source assembly. As noted above, the inappropriateness of is temperature dependent. More specifically, the dissolution of the copper is temperature dependent. Thus, since the temperatures within a neutron source assembly are very high, the use of liquid gallium as a coolant in a copper based neutron source assembly would be very problematic because the copper based neutron source assembly would begin to dissolve in the presence of the liquid gallium coolant.

Thus, the Examiner has failed to demonstrate how Morel et al. teaches that copper is an adequate material for use with liquid gallium in an environment that is subjected to the temperatures realized within a neutron source assembly.

In summary, the proposed combination of Eggers, Lidsky et al., Pais et al., and Alger et al. fails to render the presently claimed invention obvious to one of ordinary skill in the art because the teachings of Lidsky et al. would rendered the system of Eggers and the system of Pais et al., both, inoperable if liquid gallium were utilized as a coolant. Moreover, the proposed combination of Eggers, Lidsky et al., Pais et al., and Alger et al. fails to render the presently claimed invention obvious to one of ordinary skill in the art because the proposed combination of Eggers, Lidsky et al., Pais et al., and Alger et al. fails to disclose or suggest pumping the liquid gallium, serially, from the reservoir, through the nozzle, such that the liquid gallium impinges upon the low Z target material in the neutron source assembly and cools the target material, from the neutron source assembly directly to a heat exchanger to remove heat from the liquid gallium, and from the heat exchanger to the reservoir, as set forth by independent claim 1.

Independent Claim 5

As submitted above, independent claim 5 sets forth a neutron source assembly having a liquid cooled target. The neutron source assembly includes an accelerator based neutron source including a low Z target material that is bombarded by accelerated particles to produce a neutron flux and a cooling system to circulate liquid gallium through the accelerator based neutron source to cool the low Z target material. The cooling system includes a nozzle, the nozzle being submerged in liquid gallium to provide a submerged jet of concentrated liquid gallium in a direction normal to a non-bombarded surface of the low Z target material within the accelerator based neutron source. The cooling system further includes a reservoir of liquid gallium; a heat exchanger, and means for serially circulating the liquid gallium from the reservoir through the nozzle to impinge upon the surface of the low Z target material within the accelerator based neutron source, from the accelerator based neutron source directly to the heat exchanger, and from the heat exchanger to the reservoir.

Initially, as recognized by the Examiner, Eggers fails to disclose cooling a low Z target material of a neutron source assembly with liquid gallium. To meet this deficiency in Eggers, the Examiner asserts that Eggers can be modified by the teachings of Lidsky et al. because the Examiner alleges that the teaching of Lidsky et al. with respect to cooling a low Z target material of a neutron source assembly with liquid gallium is an acceptable equivalent to cooling with water as taught by Eggers. The Examiner's motivation is incorrect.

More specifically, the liquid gallium of Lidsky et al. is incompatible with the system of Eggers because Eggers discloses a neutron source assembly constructed of aluminum. Liquid gallium dissolves aluminum or copper in a matter of minutes or a few hours depending on temperature. Thus, one of ordinary skill in the art would not combine the teachings of Eggers with the teaching of Lidsky et al. to realize a system to cool a low Z target material of a neutron source assembly with liquid gallium because the liquid gallium would dissolve the aluminum neutron source assembly of Eggers.

Since Lidsky et al. discloses a coolant, liquid gallium, which would dissolve the aluminum neutron source assembly of Eggers, the proposed combination of Eggers, Lidsky et al., and Pais et al. fails because the teachings of Lidsky et al. are antithetical to the teachings

Eggers in that the system of Eggers would be rendered inoperable if liquid gallium were utilized as a coolant.

Moreover, as recognized by the Examiner, Eggers, and Lidsky et al., singly or in combination, fail to disclose a nozzle submerged in liquid gallium. To meet this deficiency in Eggers, and Lidsky et al., the Examiner asserts that Eggers and Lidsky et al. can be modified by the teachings of Pais et al. because the Examiner alleges that the teaching of Pais et al. a nozzle submerged for cooling a low Z target material of a neutron source assembly. The Examiner's motivation is incorrect.

The liquid gallium of Lidsky et al. is incompatible with the system of Pais et al. because Pais et al. discloses passing the coolant over a block of copper. As noted above, liquid gallium dissolves copper in a matter of minutes or a few hours depending on temperature. Thus, one of ordinary skill in the art would not combine the teachings of Lidsky et al. with the teaching of Pais et al. to realize a nozzle submerged for cooling a low Z target material of a neutron source assembly because the liquid gallium would dissolve the copper block of Pais et al.

Since Lidsky et al. discloses a coolant, liquid gallium, which would dissolve the copper block of Pais et al., the proposed combination of Eggers, Lidsky et al., and Pais et al. fails because the teachings of Lidsky et al. are antithetical to the teachings Pais et al. in that the system of Pais et al. would be rendered inoperable if liquid gallium were utilized as a coolant.

Furthermore, as recognized by the Examiner, Eggers, Lidsky et al., and Pais et al., singly or in combination, fail to disclose pumping the liquid gallium, serially, from the reservoir, through the nozzle, such that the liquid gallium impinges upon the low Z target material in the neutron source assembly and cools the target material, from the neutron source assembly directly to a heat exchanger to remove heat from the liquid gallium, and from the heat exchanger to the reservoir, as set forth by independent claim 5.

To meet this deficiency in the combined teachings of Eggers, Lidsky et al., and Pais et al., the Examiner proposes to modify the teachings with the teachings of Alger et al. The Examiner contends that Alger et al. teaches pumping the liquid gallium, serially, from the reservoir, through the nozzle, such that the liquid gallium impinges upon the low Z target material in the neutron source assembly and cools the target material, from the neutron source

assembly directly to a heat exchanger to remove heat from the liquid gallium, and from the heat exchanger to the reservoir.

Notwithstanding the Examiner's contentions, Alger et al. teaches pumping a liquid coolant, serially, from the reservoir (23), through the nozzle (29), such that the liquid coolant impinges upon a target material (11) in chamber (13) and cools the target material (11). Alger et al. further teaches that the liquid coolant exits the chamber (13) and flows directly back to the reservoir (23). Lastly, Alger et al. teaches that the liquid coolant in the reservoir (23) may be pumped serially, from the reservoir (23), back through the nozzle (29), or the liquid coolant in the reservoir (23) may travel through a heat exchanger (28). In other words, Alger et al. teaches that the liquid coolant leaving the chamber (13) is fed directly to the reservoir (23) and that the liquid coolant may pass through the heat exchanger (28).

Thus, Alger et al., unequivocally, fails to disclose or suggest pumping the liquid gallium, serially, from the reservoir, through the nozzle, such that the liquid gallium impinges upon the low Z target material in the neutron source assembly and cools the target material, from the neutron source assembly directly to a heat exchanger to remove heat from the liquid gallium, and from the heat exchanger to the reservoir, as set forth by independent claim 5.

Lastly, in addressing the Applicant's arguments, the Examiner dismisses the contention that the liquid gallium of Lidsky et al. is incompatible with the systems of Eggers and Pais et al. due to its corrosive nature and asserts that the Applicant has admitted that copper is a proper material for constructing a container for a liquid gallium coolant used in conjunction with a neutron source assembly.

Initially, the Examiner is respectfully requested to substantiate the validity of the Examiner's contention that the Applicant has admitted that copper is a proper material for constructing a container for a liquid gallium coolant used in conjunction with a neutron source assembly.

The original specification does discuss copper as being a material for constructing a container for a liquid gallium coolant used in conjunction with a neutron source assembly. Moreover, the Applicant has not expressly stated in any of the previous Response that copper is a proper material for constructing a container for a liquid gallium coolant used in conjunction with a neutron source assembly. Therefore, the Examiner is respectfully requested to withdraw the

unverifiable statement regarding Applicant's admissions concerning copper and further to refrain from making such unverifiable statements in future Office Actions.

The Examiner also asserts that Morel et al. (US Patent 6,258,620) discusses a liquid gallium container made of copper. It is respectfully noted that the Examiner has failed to formally include Morel et al. as a reference upon which the rejection under 35 U.S.C. §103 is based.

Although Morel et al. discloses, at column 5, lines 15-27, a shallow container made of copper for providing a liquid gallium sputtering source, Morel et al. fails to disclose liquid gallium can be utilized with a copper or aluminum based neutron source assembly as disclosed by Eggers.

It is respectfully submitted that shallow container made of copper for providing a liquid gallium sputtering source, as taught by Morel et al., is not subjected to the temperatures experienced within a neutron source assembly. As noted above, the inappropriateness of is temperature dependent. More specifically, the dissolution of the copper is temperature dependent. Thus, since the temperatures within a neutron source assembly are very high, the use of liquid gallium as a coolant in a copper based neutron source assembly would be very problematic because the copper based neutron source assembly would begin to dissolve in the presence of the liquid gallium coolant.

Thus, the Examiner has failed to demonstrate how Morel et al. teaches that copper is an adequate material for use with liquid gallium in an environment that is subjected to the temperatures realized within a neutron source assembly.

In summary, the proposed combination of Eggers, Lidsky et al., Pais et al., and Alger et al. fails to render the presently claimed invention obvious to one of ordinary skill in the art because the teachings of Lidsky et al. would rendered the system of Eggers and the system of Pais et al., both, inoperable if liquid gallium were utilized as a coolant. Moreover, the proposed combination of Eggers, Lidsky et al., Pais et al., and Alger et al. fails to render the presently claimed invention obvious to one of ordinary skill in the art because the proposed combination of Eggers, Lidsky et al., Pais et al., and Alger et al. fails to disclose or suggest pumping the liquid gallium, serially, from the reservoir, through the nozzle, such that the liquid gallium impinges upon the low Z target material in the neutron source assembly and cools the target material, from

the neutron source assembly directly to a heat exchanger to remove heat from the liquid gallium, and from the heat exchanger to the reservoir, as set forth by independent claim 5.

Remaining Dependent Claims

With respect to claims 4 and 7, the Applicant, for the sake of brevity, will not address the reasons supporting patentability for these individual dependent claims, as these claims depend directly from allowable independent claims 1 and 5. The Applicant reserves the right to address the patentability of these dependent claims at a later time, should it be necessary.

Accordingly, in view of the remarks set forth above, the Examiner is respectfully requested to reconsider and withdraw this rejection.

E. Rejection of Claim 8 under 35 U.S.C. §103

Claim 8 has been rejected under 35 U.S.C. §103 as being unpatentable over Eggers (US-A-5,392,319) in view of Lidsky et al. (US-A-5,784,423), Pias et al. (IEEE Article), and Alger et al. (US-A-4,141,224). This rejection is respectfully traversed.

As submitted above, independent claim 8 sets forth a liquid cooling system for a neutron source assembly. The cooling system includes a reservoir of liquid gallium; a heat exchanger; a nozzle, the nozzle being submerged in liquid gallium, to provide a submerged jet of concentrated liquid gallium in a direction normal to a non-bombarded surface of a low Z target material within the neutron source assembly; and means for serially circulating the liquid gallium from the reservoir through the nozzle to impinge upon the surface of the low Z target material within the neutron source assembly, from the neutron source assembly directly to the heat exchanger, and from the heat exchanger to the reservoir.

Initially, as recognized by the Examiner, Eggers fails to disclose cooling a low Z target material of a neutron source assembly with liquid gallium. To meet this deficiency in Eggers, the Examiner asserts that Eggers can be modified by the teachings of Lidsky et al. because the Examiner alleges that the teaching of Lidsky et al. with respect to cooling a low Z target material of a neutron source assembly with liquid gallium is an acceptable equivalent to cooling with water as taught by Eggers. The Examiner's motivation is incorrect.

More specifically, the liquid gallium of Lidsky et al. is incompatible with the system of Eggers because Eggers discloses a neutron source assembly constructed of aluminum. Liquid gallium dissolves aluminum or copper in a matter of minutes or a few hours depending on temperature. Thus, one of ordinary skill in the art would not combine the teachings of Eggers with the teaching of Lidsky et al. to realize a system to cool a low Z target material of a neutron source assembly with liquid gallium because the liquid gallium would dissolve the aluminum neutron source assembly of Eggers.

Since Lidsky et al. discloses a coolant, liquid gallium, which would dissolve the aluminum neutron source assembly of Eggers, the proposed combination of Eggers, Lidsky et al., and Pais et al. fails because the teachings of Lidsky et al. are antithetical to the teachings

Eggers in that the system of Eggers would be rendered inoperable if liquid gallium were utilized as a coolant.

Moreover, as recognized by the Examiner, Eggers, and Lidsky et al., singly or in combination, fail to disclose a nozzle submerged in liquid gallium. To meet this deficiency in Eggers, and Lidsky et al., the Examiner asserts that Eggers and Lidsky et al. can be modified by the teachings of Pais et al. because the Examiner alleges that the teaching of Pais et al. a nozzle submerged for cooling a low Z target material of a neutron source assembly. The Examiner's motivation is incorrect.

The liquid gallium of Lidsky et al. is incompatible with the system of Pais et al. because Pais et al. discloses passing the coolant over a block of copper. As noted above, liquid gallium dissolves copper in a matter of minutes or a few hours depending on temperature. Thus, one of ordinary skill in the art would not combine the teachings of Lidsky et al. with the teaching of Pais et al. to realize a nozzle submerged for cooling a low Z target material of a neutron source assembly because the liquid gallium would dissolve the copper block of Pais et al.

Since Lidsky et al. discloses a coolant, liquid gallium, which would dissolve the copper block of Pais et al., the proposed combination of Eggers, Lidsky et al., and Pais et al. fails because the teachings of Lidsky et al. are antithetical to the teachings Pais et al. in that the system of Pais et al. would be rendered inoperable if liquid gallium were utilized as a coolant.

Furthermore, as recognized by the Examiner, Eggers, Lidsky et al., and Pais et al., singly or in combination, fail to disclose pumping the liquid gallium, serially, from the reservoir, through the nozzle, such that the liquid gallium impinges upon the low Z target material in the neutron source assembly and cools the target material, from the neutron source assembly directly to a heat exchanger to remove heat from the liquid gallium, and from the heat exchanger to the reservoir, as set forth by independent claim 1.

To meet this deficiency in the combined teachings of Eggers, Lidsky et al., and Pais et al., the Examiner proposes to modify the teachings with the teachings of Alger et al. The Examiner contends that Alger et al. teaches pumping the liquid gallium, serially, from the reservoir, through the nozzle, such that the liquid gallium impinges upon the low Z target material in the neutron source assembly and cools the target material, from the neutron source

assembly directly to a heat exchanger to remove heat from the liquid gallium, and from the heat exchanger to the reservoir.

Notwithstanding the Examiner's contentions, Alger et al. teaches pumping a liquid coolant, serially, from the reservoir (23), through the nozzle (29), such that the liquid coolant impinges upon a target material (11) in chamber (13) and cools the target material (11). Alger et al. further teaches that the liquid coolant exits the chamber (13) and flows directly back to the reservoir (23). Lastly, Alger et al. teaches that the liquid coolant in the reservoir (23) may be pumped serially, from the reservoir (23), back through the nozzle (29), or the liquid coolant in the reservoir (23) may travel through a heat exchanger (28). In other words, Alger et al. teaches that the liquid coolant leaving the chamber (13) is fed directly to the reservoir (23) and that the liquid coolant may pass through the heat exchanger (28).

Thus, Alger et al., unequivocally, fails to disclose or suggest pumping the liquid gallium, serially, from the reservoir, through the nozzle, such that the liquid gallium impinges upon the low Z target material in the neutron source assembly and cools the target material, from the neutron source assembly directly to a heat exchanger to remove heat from the liquid gallium, and from the heat exchanger to the reservoir, as set forth by independent claim 8.

Lastly, in addressing the Applicant's arguments, the Examiner dismisses the contention that the liquid gallium of Lidsky et al. is incompatible with the systems of Eggers and Pais et al. due to its corrosive nature and asserts that the Applicant has admitted that copper is a proper material for constructing a container for a liquid gallium coolant used in conjunction with a neutron source assembly.

Initially, the Examiner is respectfully requested to substantiate the validity of the Examiner's contention that the Applicant has admitted that copper is a proper material for constructing a container for a liquid gallium coolant used in conjunction with a neutron source assembly.

The original specification does discuss copper as being a material for constructing a container for a liquid gallium coolant used in conjunction with a neutron source assembly. Moreover, the Applicant has not expressly stated in any of the previous Response that copper is a proper material for constructing a container for a liquid gallium coolant used in conjunction with a neutron source assembly. Therefore, the Examiner is respectfully requested to withdraw the

unverifiable statement regarding Applicant's admissions concerning copper and further to refrain from making such unverifiable statements in future Office Actions.

The Examiner also asserts that Morel et al. (US Patent 6,258,620) discusses a liquid gallium container made of copper. It is respectfully noted that the Examiner has failed to formally include Morel et al. as a reference upon which the rejection under 35 U.S.C. §103 is based.

Although Morel et al. discloses, at column 5, lines 15-27, a shallow container made of copper for providing a liquid gallium sputtering source, Morel et al. fails to disclose liquid gallium can be utilized with a copper or aluminum based neutron source assembly as disclosed by Eggers.

It is respectfully submitted that shallow container made of copper for providing a liquid gallium sputtering source, as taught by Morel et al., is not subjected to the temperatures experienced within a neutron source assembly. As noted above, the inappropriateness of is temperature dependent. More specifically, the dissolution of the copper is temperature dependent. Thus, since the temperatures within a neutron source assembly are very high, the use of liquid gallium as a coolant in a copper based neutron source assembly would be very problematic because the copper based neutron source assembly would begin to dissolve in the presence of the liquid gallium coolant.

Thus, the Examiner has failed to demonstrate how Morel et al. teaches that copper is an adequate material for use with liquid gallium in an environment that is subjected to the temperatures realized within a neutron source assembly.

In summary, the proposed combination of Eggers, Lidsky et al., Pais et al., and Alger et al. fails to render the presently claimed invention obvious to one of ordinary skill in the art because the teachings of Lidsky et al. would rendered the system of Eggers and the system of Pais et al., both, inoperable if liquid gallium were utilized as a coolant. Moreover, the proposed combination of Eggers, Lidsky et al., Pais et al., and Alger et al. fails to render the presently claimed invention obvious to one of ordinary skill in the art because the proposed combination of Eggers, Lidsky et al., Pais et al., and Alger et al. fails to disclose or suggest pumping the liquid gallium, serially, from the reservoir, through the nozzle, such that the liquid gallium impinges upon the low Z target material in the neutron source assembly and cools the target material, from

the neutron source assembly directly to a heat exchanger to remove heat from the liquid gallium, and from the heat exchanger to the reservoir, as set forth by independent claim 8.

Accordingly, in view of the remarks set forth above, the Examiner is respectfully requested to reconsider and withdraw this rejection.

CONCLUSION

Accordingly, in view of all the reasons set forth above, the Examiner is respectfully requested to reconsider and withdraw all the present rejections. Also, an early indication of allowability is earnestly solicited.

Respectfully submitted,

A handwritten signature in black ink, appearing to read "Matthew E. Connors", written over a horizontal line.

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